Claims

1. A system for optimizing the recovery of argon comprising:

an air input subsystem configured to intake and process atmospheric air;

at least one distillation column to receive a processed air stream from the air input and to output a raw argon stream, wherein the at least one distillation column is located downstream from the air input system;

a crude argon column to receive and process the raw argon stream and to output a crude argon stream; and

a controller to automatically control the composition of the raw argon stream so as to decrease a concentration of oxygen in the raw argon stream while preventing a concentration of nitrogen in the crude argon stream from exceeding a selected value.

2. The system of claim 1, wherein the controller further controls the composition of the crude argon stream to adjust an oxygen concentration of the crude argon stream toward a selected value.

3. The system of claim 2, wherein the selected value for the oxygen concentration of the crude argon stream is not more than about 4%.

4. The system of claim 2, wherein the selected value for the oxygen concentration of the crude argon stream is not more than about 4 ppm.

5. The system of claim 1, wherein the selected value for the nitrogen concentration of the crude argon stream is less than about 5%.

6. The system of claim 1, wherein the controller is a multivariable predictive controller that effects control of at least one constraint variable and to at least one manipulated variable.

7. The system of claim 6, wherein the at least one constraint variable includes at least one of: gas oxygen flow purity, raw argon flow purity, vented

gas oxygen flow amount, low-pressure nitrogen purity, liquid nitrogen reflux impurity, raw argon stream midpoint purity, amount of oxygen in the crude argon stream, and amount of nitrogen in the crude argon stream.

8. The system of claim 6, wherein the at least one manipulated variable includes at least one of: gaseous oxygen flow amount out of the low-pressure column, liquid nitrogen reflux flow amount into the low-pressure column, liquid nitrogen assist flow amount into the low-pressure column, crude argon flow amount drawn from the crude argon column, and air flow amount from the air input subsystem.

9. The system of claim 6, wherein the controller further effects control by selectively regulating the composition of the raw argon stream by either increasing the concentration of oxygen in the raw argon stream to approach an upper oxygen concentration limit or decreasing the concentration of the oxygen in the raw argon stream to approach a lower oxygen concentration limit.

10. In a system including an air intake subsystem, at least one distillation column, a crude argon distillation column, and a controller; a process for optimizing the recovery of argon in a an air separation unit comprising the steps of:

(a) directing a flow of atmospheric air into the air intake subsystem and processing the atmospheric air;

(b) directing the processed air from the air intake subsystem into at least one distillation column to produce at least one raw argon stream;

(c) directing the at least one raw argon stream from the at least one distillation column to a crude argon distillation column to process the raw argon stream and to output a crude argon stream; and

(d) automatically controlling the composition of the raw argon stream via the controller so as to decrease a concentration of oxygen in the raw argon stream while preventing a concentration of nitrogen in the crude argon stream from exceeding a selected value.

11. The process of claim 10, wherein step (e) further includes:

(e.1) automatically controlling the composition of the crude argon stream until the oxygen concentration of the crude argon stream reaches a selected value.

12. The process of claim 11, wherein the selected value for the oxygen concentration of the crude argon stream is not more than about 4.0 ppm.

13. The process of claim 11, wherein the selected value for the oxygen concentration of the crude argon stream is not more than about 4.0 ppm.

14. The process of claim 10, wherein the selected value for the nitrogen concentration of the crude argon stream is less than about 5%.

15. The process of claim 10 wherein the controller is a multivariable predictive controller that effects control of at least one constraint variable and at least one manipulated variable.

16. The process of claim 15, wherein the at least one constraint variable includes at least one of: gas oxygen flow purity, raw argon flow purity, amount of vented gas oxygen flow, low-pressure nitrogen purity, liquid nitrogen reflux impurity, raw argon stream midpoint purity, amount of oxygen in the crude argon stream, and amount of nitrogen in the crude argon stream.

17. The process of claim 15, wherein the at least one manipulated variable includes at least one of: amount gaseous oxygen flow out of the low-pressure column, amount of liquid nitrogen reflux flow into the low-pressure column, amount of liquid nitrogen assist flow into the low-pressure column, amount of crude argon flow drawn from the crude argon column, and amount of air flow drawn into the air intake.

18. The process of claim 15, wherein the controller further effects control through selective regulation of the composition of the raw argon stream by

either increasing the concentration of oxygen in the raw argon stream to approach an upper oxygen concentration limit or decreasing the concentration of oxygen in the raw argon stream to approach a lower oxygen concentration limit.